DEVICE FOR PRODUCING CASTINGS IN WHICH THE WALL OF THE DEVICE MOVES INTO THE MOLD

The invention relates to a device according to the preamble of claim 1.

European Patent 1 046 444 A1 discloses a device of this type according to the species. Three pistons are used to create a variable-volume chamber for the injection material. In it, two pistons are axially movable within a tubular cavity, and a third piston can be moved perpendicularly to the longitudinal axis of the chamber between the two above-mentioned pistons so as to convey the material into the mold cavity. The requirement here is that there be a precise seal between the three pistons relative to one another and to the chamber. Because of the space requirement and the demands on the seal, the device according to the species is very expensive to produce.

German Patent 199 14 830 A1 describes a device in which two walls designed as a valve and a piston are axially movable within the tubular cavity. They adjoin a runner through which the injection material enters the actual mold cavity.

German Patent 43 10 755 A1 describes a device in which two walls, one designed as a nondriven movable clamping disk and the other as a driven piston, are axially movable within a tubular cavity. They adjoin a runner through which the injection material enters the actual mold cavity.

Replaceable mold inserts which may form sections of the wall of the mold cavity are known from Ernst Brunnhuber, "*Moderne Druckgussfertigung*" [Modern Die-Casting], Fachverlag Schiele und Schön GmbH, Berlin, 1971, pages 137 and 139.

The goal of the present invention is to improve a device according to the species so that it is as efficient as possible, has compact dimensions, and can be operated as inexpensively as possible.

This goal of the invention is achieved by a device having the characteristic features of Claim 1.

In other words, the invention proposes an approach in which the movable chamber walls are located not exclusively outside the mold but are disposed to allow

displacement of the chamber contents into the mold. This approach results in a savings in material since the spruc can be avoided or considerably reduced. As a result, a reduction can be made in the quantity of material in circulation which must be re-cooled and re-melted for each cycle, with the possible ensuing melting loss in expensive alloy elements, this melting loss having to be continually replaced.

Since the sprue/runner can be reduced or completely eliminated, the amount of heated material, and thus the heat load on the injection unit and the mold itself, are also reduced, thereby allowing for shorter cool-down phases and consequently for a higher number of pieces produced per unit time.

Since the material enters the mold directly from the chamber without any intermediate injection channel, larger flow cross-sections can be used and, as a result, possible deviations in material flow can be avoided. The material therefore does not need to be heated to as high a temperature as it otherwise would to permit the optimal flow-through capability into the mold for comparatively smaller inlet ports or to permit the proper flow over long distances. The result is that a lower temperature level can be set for the molten metal – with the result that this measure allows the heat load on the device to be reduced, as already mentioned, shortens cool-down times, and enhances the efficiency of the device.

The fact that deviations in material flow can be avoided allows the load on the device to be reduced since such deviations may result in premature wear and actual erosion. In addition, this fact may allow for a reduction in required impelling power since the conveying resistance of the material can be reduced.

The fact that the injection unit extends into the mold and is not located exclusively outside the mold means that the device can be produced with compact dimensions. This feature is enabled specifically by the fact that one of the two walls does not merely extend up to the edge of the mold but may be moved into the mold.

One of the two movable walls of the injection unit chamber may be advantageously designed as the section of the wall of the mold cavity which is designed to be movable for the purpose of opening the mold. This approach avoids complex multi-axial movements and ensures that, when the mold is opened, this injection unit wall, which is movable into the casting mold, is moved together with the section of the

mold to be opened – thereby allowing the access to the casting when the mold is opened to remain unchanged and allowing optimal access to the casting for its removal.

The following discussion utilizes an embodiment to explain the invention in greater detail.

Figures 1 through 6 showa device for producing castings at various phases of the casting process.

Reference 1 in Figure 1 designates a device for producing castings in a pressure die-casting process.

Device 1 has a two-part mold 2 which in Figure 1 is seen in its closed configuration. Device 1 additionally has an injection unit 3 which serves to inject the fusible material into the mold 2. Figure 1 shows injection unit 3 in an initial phase of its filling process:

A conveying unit 4 conveys the molten or at least partially molten material into a chamber 5 of injection unit 3. The chamber walls are formed by a round tube 6, an injection piston 7, and a sealing piston 8.

In Figure 1, the volume of chamber 5 is comparatively small. The chamber volume can be kept to an extreme minimum by moving the two pistons 7 and 8 very close together. There is assurance at all times that even oxidation-prone material can be readily processed since any contact with ambient air is essentially precluded. The material is conveyed by conveying unit 4 into chamber 5, while sealing piston 8 is increasingly moved away from injection piston 7 to adjust for the quantity of admitted material, as Figure 2 shows.

Figure 2 shows injection unit 3 in an end phase of filling when injection unit 3 is essentially filled with the casting material. The volume of chamber 5 has increased accordingly, and injection piston 7 continues to be situated at a position in which the access for conveying unit 4 into chamber 5 is open.

Once the desired quantity of material has been admitted to chamber 5, the two pistons 7 and 8 move together. As is evident in Figure 3, the result is that chamber 5 is now closed relative to conveying unit 4.

Sealing piston 8 is moved out of tube 6 and into mold 2. This action opens tube 6 and thus, chamber 5. A further movement of injection piston 7 causes the material to be injected from chamber 5 into mold 2.

Figure 4 shows the end position of injection piston 7. Sealing piston 8 is located inside mold 2 at a position in which it forms part of the wall of mold 2, which part limits the mold cavity 9 which in turn determines the subsequent contour of the casting. In the embodiment shown, this is a casting, for example, a rotationally symmetrical component such as a wheel, a cover, or the like, in the shaping of which sealing piston 8 directly participates, and which may be accordingly designed so as to determine the desired surface shape of the casting. In this case, the sprue point into the casting can be displaced such that advantageously there is no "sprue" in the conventional sense, i.e., a part which must be removed from the casting and can be used only as recycled material.

Alternatively, the approach may be to have one or more individual end products arranged radially around the region of the two pistons 7 and 8 such that the casting produced comprises this number of products plus a sprue which extends from the region between pistons 7 and 8 up to these products. The sprue is thus minimal and has no components extending out of the actual mold 2. In this case, injection piston 7 can extend further than shown in Figure 3 to keep the material thickness of the sprue as small as possible.

In Figure 5, it is evident that mold 2 is open. For this purpose, mold 2 consists of a fixed mold section 10 and another movable mold section 11. Sealing piston 8 is supported within the movable mold section 11 and is movable together with or separately from movable mold section 11 such that, after mold 2 is opened, the casting can be removed easily and with the same accessibility as with a conventional injection unit in which all the components are located outside mold 2.

After removal of the casting, movable mold section 11 may again be moved toward fixed section 10 of the mold. This motion results also in sealing piston 8 being moved toward injection piston 7 which has remained in its end position. Figure 6 shows in purely schematic form that sealing piston 8 has preferably been moved up to injection piston 7 in order to create a minimum volume in chamber 5 before mold 2 is completely closed. This allows for easy venting of the surrounding atmosphere so that

chamber 5 is set for a minimum chamber volume. For safety reasons only, meaning the avoidance of mechanical damage to pistons 7 and 8, the design of the piston control shown provides that pistons 7 and 8 do not directly contact each other.

Starting with the status shown in Figure 6, mold 2 is closed, i.e., the movable section 11 is moved completely against fixed mold section 10 after which the backplates of mold 2 are locked so that it is ready to receive the injection pressures.

One advantage of the device according to the invention is that sealing piston 8 is allowed to rest against movable mold section 11 during the injection procedure – with the result that, advantageously, no expensive and design-specific provision has to be made in terms of a separate support for sealing piston 8 since the injection pressures acting on sealing piston 8 are accommodated by mold 2 or its backplates.

Subsequent to the situation in Figure 6 and after mold 2 has been closed, chamber 5 is displaced by a movement of the same direction and speed effected by pistons 7 and 8 until chamber 5 is situated in front of the opening of conveying unit 4 so that a new operating cycle can take place.